OPTICAL AND PHYSICAL PROPERTIES OF EUROPIUM DOPED LITHIUM POTASSIUM BORATE GLASS

MAJDI MOHAMMAD ALAYAN MAQABLEH

A project report submitted in partial fulfilment of the requirements for the award of the degree of
Master of Science (Physics)

Faculty of Science
Department of Physics
Universiti Teknologi Malaysia

OCTOBER 2013
I dedicate this work

To my dear parents
Whose love, kindness, patience and prayer have brought me this far

To my siblings
To my wife
For their endless laughs and tears

To my nieces and nephews
Whose presence fills my life with joy

To my friends
For their love, understanding and support through my endeavour
ACKNOWLEDGEMENT

First and foremost, my unlimited and sincere appreciation goes to the Lord of the seven heavens and earth ALLAH (SWT) for His endless mercies, blessings and guidance through from birth till now and forever. Alhamdullahi Robi Alamin.

My sincere appreciation also goes to my supervisor the person of DR SuhairulHashim for his continued guidance, support and encouragement to ensure this work is a success. My earnest appreciation also goes to all my friends and well wishers that contributed to the success of this study and the knowledge acquired in cause. To you all I say thank you.

I shall forever be grateful to my parent, my siblings, their families and my wife for their belief in me even when I did not and for their unending support, spiritually and emotionally. To them I am highly indebted and words alone cannot describe my gratitude. I pray ALLAH (SWT) make you reap the fruit of your labour on me, Jazakum Allahu Khyran.
ABSTRACT

Borate glass is widely used in many scientific studies. By using melt-quenching technique five samples of lithium potassium borate (LKB) doped with different concentration of europium oxide (Eu$_2$O$_3$) were prepared. To investigate the influence of dopant on the optical and physical characteristics of the glass, X-ray Diffraction and photoluminescence analyses were performed. The amorphous nature was confirmed by X-ray diffraction. The physical parameters of the glass which was doped by different oxidation state have been analyzed. These parameters involved are density, molar volume, ion concentration, inter-nuclear distance and Polaron radius. The exchange in the concentration of Eu$^{+3}$ indicated the influence of Eu as a dopant on the photoluminescence emission of LKB glasses. The photoluminescence emission spectrum of LKB:Eu$^{+3}$were due to the transition of Eu$^{3+}$ from $^5$D$_0$-$^7$F$_r$ ($r =1, 2, 3$ and $4$). The luminescence studies showed four peaks (590 nm, 613 nm, 650 nm, and 698 nm) for all samples excluding the pure sample. The glow curve exhibits single peak at 164 °C. We establish that the proposed TL dosimeter at 0.5 mol% of Eu$^{3+}$ has been observed to be 20 times less sensitive than TLD-100.
ABSTRAK

Kaca borat banyak digunakan dalam kajian saintifik. Dengan menggunakan teknik sepuh-lindap, 5 sampel litium potassium borat yang dengan europium oksida (Eu$_2$O$_3$) yang mempunyai kepekatan yang berbeza disediakan. Bagi mengkaji kesan dopan terhadap ciri-ciri optikal dan fizikal bagi kaca, analisis pembelauan sinar-X dan fotoluminesens telah dilakukan. Sifat amorfus bahan telah dibuktikan dengan pembelauan sinar-X. Parameter fizikal bagi kaca yang didop dengan aras pengoksidaan berbeza dianalisis. Parameter yang terlibat adalah ketumpatan, isipadu molar, kepekatan ion, jarak antara nukleus dan jejari Polaron. Perubahan kepekatan Eu$^{3+}$ menunjukkan kesan Eu sebagai dopan dalam pancaran fotoluminesens kaca LKB. Pancaran spektra luminesens disebabkan peralihan Eu$^{3+}$ dari $^5$D$_0$-$^7$F$_r$ (r=1, 2, 3 dan 4). Kajian luminesens menunjukkan 4 puncak (590 nm, 613 nm, 650 nm dan 698 nm) untuk semua sampel kecuali sampel tulen. Satu lengkung berbara menunjukkan puncak tunggal pada 164°C. Dosimeter TL yang dicadangkan ini menunjukkan kepekaan 20 kali lebih rendah berbanding TLD-100 pada kepekatan 0.5 mol % Eu$^{3+}$. 